PATENT ABSTRACTS OF JAPAN

(11)Publication number : 11-015079

(43)Date of publication of application : 22.01.1999

---

(51)Int.Cl. G03B 21/62
G02F 1/1335
H04N 5/74
H05B 33/22

---

(21)Application number : 09-166416 (71)Applicant : SEIKO EPSON CORP

(22)Date of filing : 23.06.1997 (72)Inventor : YOKOYAMA OSAMU
SHIMODA TATSUYA
MIYASHITA SATORU

---

(54) DISPLAY DEVICE

(57)Abstract:
PROBLEM TO BE SOLVED: To miniaturize a projection optical system constituting a display device by which a background existing behind a screen can be viewed through the screen.
SOLUTION: A liquid crystal display element 103 is illuminated by a plate-like organic electric field light emitting element 104 arranged at the back of the element 103. A picture displayed on the element 103 is projected to a dichroic screen 101 by a projection lens 105. The screen 101 is provided with a dichroic filter layer 108 on a transparent base plate 107. The layer 108 reflects only the light of a wavelength band corresponding to the wavelength of the light radiated from the element 104 and transmits the light of other wavelength bands.

LEGAL STATUS [Date of request for examination]

[Date of sending the examiner's decision of rejection]

[Kind of final disposal of application other than the examiner's decision of rejection or application converted registration]

[Date of final disposal for application]

[Patent number]

[Date of registration]

[Number of appeal against examiner's decision of rejection]

[Date of requesting appeal against examiner's decision of rejection]

[Date of extinction of right]

CLAIMS

[Claim(s)]

[Claim 1] In the display equipped with the screen arranged between a liquid crystal display component, the organic electroluminescence devices which illuminate this liquid crystal display component, the projection lens which projects the light modulated with said liquid crystal display component, and this projection lens and an observer The display characterized by having the structure of said screen reflecting the light of the wavelength band corresponding to the luminescence wavelength of said organic electroluminescence devices, and making the light of other wavelength bands penetrating.

[Claim 2] The 1st [corresponding to the three primary colors], 2nd, and 3rd liquid crystal display components, and the 1st, the 2nd and 3rd organic electroluminescence devices which illuminate each of said liquid crystal display component, In the display equipped with the screen arranged between the color composition optical system which compounds the light modulated by each of said liquid crystal display component, the projection lens which projects the image compounded by this color composition optical system, and this projection lens and an observer Said screen reflects the light of the wavelength band corresponding to the luminescence wavelength of said 1st organic electroluminescence devices. The light of the wavelength band corresponding to the luminescence wavelength of the 1st structure of making the light of other wavelength bands penetrating, and said 2nd organic electroluminescence devices is reflected. The display characterized by having the 3rd structure of reflecting the light of the wavelength band corresponding to the luminescence wavelength of the 2nd structure of making the light of other wavelength bands penetrating, and said 3rd organic electroluminescence devices, and making the light of other wavelength bands penetrating.

DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates especially to the configuration of the light source about the display which projects and displays the image displayed on a display device on the screen which has dichroism in a reflection factor.

[0002]

[Description of the Prior Art] Conventionally, in the projection mold liquid crystal display which expands and projects the image displayed on a liquid crystal display component, the reflexible screen was used as a screen.

[0003] Moreover, there was the so-called HUD which displays the virtual image to which the display device was expanded, using a dichroic mirror or a holographic mirror as a display using the screen which has light transmission nature.

[0004] In the HUD, in order to obtain a bright display image, the cathode-ray tube (CRT) was used as image generation equipment. Moreover, the HUD using the liquid crystal display component as image generation equipment had become the configuration which illuminates a liquid crystal display component by making a discharge lamp into the light source.

[0005] Moreover, a dichroic mirror or a holographic mirror reflects only the light of the wavelength band corresponding to the wavelength of the light emitted from image generation equipment, and light other than this wavelength band has composition made to penetrate. Therefore, the background which spaces these mirrors and is in the other side of a mirror can be seen.

[0006]

[Problem(s) to be Solved by the Invention] However, in the above-mentioned conventional projection mold liquid crystal display, since the screen was a reflective mold, it had the trouble that the background which spaces a screen and is in the backside [a screen] could not be seen.

[0007] Moreover, in the above-mentioned conventional HUD, since CRT and a discharge lamp were used as image generation equipment, it had the trouble that a display could not be miniaturized.

[0008] Then, this invention aims at offering the display which can see the background of a screen, though it is small.

[0009]

[Means for Solving the Problem] The organic electroluminescence devices to which a display according to claim 1 illuminates a liquid crystal display component and this liquid crystal display component, In the display equipped with the screen arranged between the projection lens which projects the light modulated with said liquid crystal display component, and this projection lens and an observer Said screen reflects the light of the wavelength band corresponding to the luminescence wavelength of said organic electroluminescence devices, and it is characterized by having the structure of making the light of other wavelength bands penetrating.

[0010] According to the above-mentioned configuration, in the display which can see the background which is behind said screen through said screen, it has the effectiveness that the projection optical system which constitutes a display can be miniaturized.

[0011] The 1st corresponding to the three primary colors in a display according to claim 2, the 2nd, and the 3rd liquid crystal display component, The 1st, the 2nd, and 3rd organic electroluminescence devices which illuminate each of said liquid crystal display component, In the display equipped with the screen arranged between the color composition optical system which compounds the light modulated by each of said liquid crystal display component, the projection lens which projects the image compounded by this color composition optical system, and this projection lens and an observer Said screen reflects the light of the wavelength band corresponding to the luminescence wavelength of said 1st organic electroluminescence devices. The light of the wavelength band corresponding to the luminescence wavelength of the 1st structure of making the light of other wavelength bands penetrating, and said 2nd organic electroluminescence devices is reflected. The light of the wavelength band corresponding to the luminescence wavelength of the 2nd structure of making the light of other wavelength bands penetrating, and said 3rd organic electroluminescence devices is reflected, and it is characterized by having the 3rd structure of making the light of other wavelength bands penetrating.

[0012] According to the above-mentioned configuration, while being able to project a full color image on said screen, in the display which can see the background of said screen through said screen, it has the effectiveness that the projection optical system which constitutes a display can be miniaturized.

[0013]

[Embodiment of the Invention] Hereafter, the operation gestalt of this invention is

explained based on a drawing.

[0014] (1st operation gestalt) The 1st operation gestalt of the display of this invention is explained using drawing 1 , drawing 2 , and drawing 3 . Drawing 1 is the sectional view showing the main optical system in the 1st operation gestalt of the display of this invention. Drawing 2 is the reflection factor spectrum of the die clo IKKU filter layer which constitutes the die clo IKKU screen used with the 1st operation gestalt of the display of this invention. Drawing 3 is the sectional view showing the structure of the organic electroluminescence devices used with the 1st operation gestalt of the display of this invention.

[0015] The organic electroluminescence devices 104 and the projection lens 105 which have been arranged at the tooth back of the liquid crystal display component 103 of a transparency mold and the liquid crystal display component 103 are built into a case 106, and constitute the projection optical system 100. The display consists of projection optical system 100 and a die clo IKKU screen 101.

[0016] In drawing 1 , in order to make drawing legible, electronic circuitries, such as a circuit which turns on the circuit or the organic electroluminescence devices 104 for displaying an image on the liquid crystal display component 103, are excluded and drawn. Moreover, although the projection lens 105 is also drawn as one lens, it consists of two or more lenses in fact. Moreover, the cooler style which cools the organic electroluminescence devices 104 is excluded and drawn.

[0017] The die clo IKKU screen 101 has the composition that the die clo IKKU filter layer 108 which consists of dielectric multilayers was formed in one field of the transparence substrate 107 which consists of glass. The laminated structure which consists of thin films, such as a dielectric thin film, a semi-conductor thin film, and a metal thin film, as a die clo IKKU filter layer which shows dichroism to a reflection factor can be used. Moreover, it is also possible to use a transparence resin film as a transparence substrate 107.

[0018] The die clo IKKU filter layer 108 reflects the light of the wavelength of a green field, and shows the reflection factor spectrum to drawing 2 . Light with a wavelength of 510-570nm is reflected at 50% or more of reflection factors focusing on 540nm among the light which carried out incidence almost at right angles to the die clo IKKU filter layer 108. The light of other wavelength penetrates the die clo IKKU filter layer 108, and penetrates the die clo IKKU screen 101.

[0019] The cross-section structure of the organic electroluminescence devices 104 is shown in drawing 3 . In drawing 3 , in order to make drawing legible, the thickness of a thin film is emphasized and it has drawn.

[0020] It has the structure where the laminating of the ITO (indium stannic acid ghost) thin film used as an anode plate 301, the TPD (triphenyl diamine derivative) thin film used as the electron hole transportation layer 302, Alq3 (tris (8-kino RINONATO) aluminum) thin film used as a luminous layer 303, and the MgAg thin film used as cathode 304 was carried out to one field of a glass substrate 300 one by one.

[0021] From the organic electroluminescence devices of such structure, the synchrotron orbital radiation 305 in which peak wavelength has the emission spectrum whose full width at half maximum is about 100nm in 530nm is emitted.

[0022] Since the wavelength band of the light emitted from the organic electroluminescence devices 104 is larger than the reflected wave length band of the die clo IKKU filter layer 108 shown in drawing 2 , the light of the wavelength contained in the reflected wave length band of the die clo IKKU filter layer 108 will be reflected, and the light of the wavelength which is not contained in a reflected wave length band will penetrate the die clo IKKU filter layer 108.

[0023] The thickness of a glass substrate 300 is about 1mm. If area size of each above-mentioned thin film layer currently formed on the glass substrate is set to 29mmx22mm, this field will turn into a luminescence field and light will be emitted from the whole surface of this field.

[0024] If magnitude of the viewing area of the liquid crystal display component 103 is set to 27mmx22mm, this viewing area is smaller than the luminescence field of the organic electroluminescence devices 104, and can be illuminated by the organic electroluminescence devices 104.

[0025] According to the configuration of a display which was described above, it is illuminated by the organic electroluminescence devices 104 to which the liquid crystal display component 103 is green, and emits light from a tooth back, and the image displayed on the liquid crystal display component 103 is projected on the die clo IKKU screen 101 with the projection lens 105.

[0026] If a die clo IKKU screen is arranged so that the normal of the die clo IKKU screen 101 may be mostly in agreement with the optical axis of the projection lens 105, and an observer 102 looks at the die clo IKKU screen 101 from the location near the optical axis of the projection lens 105, an observer 102 can see a green image on a die clo IKKU screen.

[0027] On the other hand, since the light of wavelength other than 510-570nm penetrates the die clo IKKU screen 101, an observer 102 can see the background from which the color corresponding to the wavelength of 510-570nm was removed among the backgrounds 109 which are behind the die clo IKKU screen 101.

[0028] Moreover, the organic electroluminescence devices 104 are the plate-like structure which carried out the laminating of the thin film on the glass substrate, and are the small light source which can emit light by the brightness of tens of thousands of cds/m2 with about [10V] direct current voltage. Therefore, it becomes possible to miniaturize the projection optical system which constitutes a display.

[0029] Moreover, since the organic electroluminescence devices 104 emit light in the field in which the diaphragm structure as shown in drawing 3 is formed, they become possible [illuminating the liquid crystal display component 103 to homogeneity], without using other optical elements.

[0030] (2nd operation gestalt) The 2nd operation gestalt of the display of this invention is explained using drawing 4 and drawing 5 . Drawing 4 is the sectional view showing the main optical system in the 2nd operation gestalt of the display of this invention. Drawing 5 is the reflection factor spectrum of the die clo IKKU filter layer which constitutes the die clo IKKU screen used with the 2nd operation gestalt of the display of this invention.

[0031] This operation gestalt is equipped with three liquid crystal display components for displaying the image of the three primary colors, i.e., red, green, and blue, and the organic electroluminescence devices which emit light in the red who illuminates each liquid crystal display component from behind, green, and blue, and has composition which compounds the image displayed on said three liquid crystal display components, and is projected on a die clo IKKU screen.

[0032] A dichroic prism 405, the transparency mold liquid crystal display components 403R, 403G, and 403B of three sheets which countered three fields of this dichroic prism and have been arranged, the organic electroluminescence devices 404R, 404G, and 404B arranged at the tooth back of each liquid crystal display component, and the projection lens 406 are built into a case 407, and constitute the projection optical system 400. The display consists of projection optical system 400 and a die clo IKKU screen 401.

[0033] In drawing 4 , in order to make drawing legible, the electronic circuitry is excluded and drawn like drawing 1 . Moreover, although the projection lens is also drawn as one lens, it consists of two or more lenses in fact. Moreover, the cooler style which cools organic electroluminescence devices is excluded and drawn.

[0034] The die clo IKKU screen 401 has the composition that the die clo IKKU filter 408 which consists of dielectric multilayers was formed in one field of the transparence substrate 409 which consists of glass. The die clo IKKU filter 408 carries out the laminating of the three die clo IKKU filter layers 408R, 408G, and 408B, and is

constituted. The die clo IKKU filter layers 408R, 408G, and 408B consist of dielectric multilayers, respectively, and the laminated structures differ.

[0035] The laminating of the dielectric multilayers is carried out so that the wavelength of a red field may be reflected alternatively, and die clo IKKU filter layer 408R shows the reflection factor spectrum with the curve referred to by R of drawing 5 . Light with a wavelength of 590-650nm is reflected at 50% or more of reflection factors focusing on 620nm among the light which carried out incidence almost at right angles to die clo IKKU filter layer 408R.

[0036] The laminating of the dielectric multilayers is carried out so that the wavelength of a green field may be reflected alternatively, and die clo IKKU filter layer 408G show the reflection factor spectrum with the curve referred to by G of drawing 5 . Light with a wavelength of 510-570nm is reflected at 50% or more of reflection factors focusing on 540nm among the light which carried out incidence almost at right angles to die clo IKKU filter layer 408G.

[0037] The laminating of the dielectric multilayers is carried out so that the wavelength of a blue field may be reflected alternatively, and die clo IKKU filter layer 408B shows the reflection factor spectrum with the curve referred to by B of drawing 5 . Light with a wavelength of 450-510nm is reflected at 50% or more of reflection factors focusing on 480nm among the light which carried out incidence almost at right angles to die clo IKKU filter layer 408B.

[0038] Light other than the wavelength band reflected in the three above-mentioned die clo IKKU filter layers 408R, 408G, and 408B penetrates the die clo IKKU filter 408, and penetrates the die clo IKKU screen 401.

[0039] Three organic electroluminescence devices 404R, 404G, and 404B consist of organic materials with which a luminous layer emits light in red, green, and a blue wavelength field, respectively.

[0040] It is green and structure of organic electroluminescence-devices 404G which emit light can be made into the structure explained with the 1st operation gestalt.

[0041] The thin film which contains Eu (europium) complex as a luminous layer which constitutes organic electroluminescence-devices 404R which emits light on the wavelength of a red field can be used. The structure of such organic electroluminescence devices is indicated by Japanese Journal of Applied Physics Vol.34 (1995) Pt.1 and No.4A pp.1883-1887. Peak wavelength of synchrotron orbital radiation can be set to about 614nm with such structure.

[0042] As an organic luminous layer which emits light on the wavelength of a red field, the ingredient which added the coloring matter which emits light in red can be used for

Alq3 besides Eu complex. Since Eu complex has the narrow emission spectrum, the luminescence wavelength is almost contained in the reflected wave length band of die clo IKKU filter layer 408R which reflects the light of the wavelength of a red field alternatively.

[0043] A distyrylbiphenyl derivative thin film can be used as a luminous layer which constitutes organic electroluminescence-devices 404B which emits light on the wavelength of a blue field. The structure of such organic electroluminescence devices is application physics. The 62nd volume No. 10 1015-1018 pages (1993) It is indicated. Peak wavelength of synchrotron orbital radiation can be set to about 480nm with such structure.

[0044] each which was emitted from three organic electroluminescence devices 404R, 404G, and 404B -- it becomes irregular with the liquid crystal display components 403R, 403G, and 403B, respectively, and the light of red, green, and blue is compounded with a dichroic prism 405.

[0045] The image compounded with the dichroic prism is projected on the die clo IKKU screen 401 with the projection lens 406.

[0046] If the die clo IKKU screen 401 is arranged so that the normal of a die clo IKKU screen may be mostly in agreement with the optical axis of the projection lens 406, and an observer 102 looks at the die clo IKKU screen 401 from the location near the optical axis of the projection lens 406, an observer 102 can see a full color image on a die clo IKKU screen.

[0047] On the other hand, since light other than the wavelength reflected with the die clo IKKU filter 408 penetrates the die clo IKKU screen 401, an observer 102 can see the background from which the color corresponding to the wavelength reflected with the die clo IKKU filter 408 among the backgrounds 410 which are behind the die clo IKKU screen 401 was removed.

[0048] Since the organic electroluminescence devices 404R, 404G, and 404B are plate-like and a liquid crystal display component can be illuminated to homogeneity as the 1st operation gestalt explained, it becomes possible to miniaturize the projection optical system which constitutes a display.

[0049] Although the operation gestalt of the display of this invention was explained above Light is emitted from the whole field in which it is plate-like and luminous layer structure is formed. A liquid crystal display component is illuminated to a pan by the organic electroluminescence devices which can carry out high brightness luminescence by the about [10V] low battery. The technique of this invention that reflect alternatively the light of the luminescence wavelength of the organic

electroluminescence devices, and the light of other wavelength constitutes a display using the die clo IKKU screen made to penetrate The configuration which leans 45 degrees of opticals axis of a projection lens, and arranges them to the normal of a die clo IKKU screen, The application to various displays, such as a configuration which looks at the virtual image to which the liquid crystal display component was expanded through the die clo IKKU screen with the combination of the configuration which uses a hologram instead of or a die clo IKKU screen, and a projection lens, is possible.
[dielectric multilayers]
[0050]
[Effect of the Invention] As stated above, according to the display of this invention, organic field-like electroluminescence devices are used as the light source which illuminates a liquid crystal display component. Since only the light of the wavelength band corresponding to the wavelength of the light emitted from the organic electroluminescence devices as a screen is reflected alternatively and the light of other wavelength bands uses the die clo IKKU screen made to penetrate In the display which can see the background which is behind a die clo IKKU screen, it has the effectiveness that the projection optical system which constitutes a display can be miniaturized.

DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The sectional view showing the main optical system in the 1st operation gestalt of the display of this invention.

[Drawing 2] The reflection factor spectrum of the die clo IKKU filter layer which constitutes the die clo IKKU screen used with the 1st operation gestalt of the display of this invention.

[Drawing 3] The sectional view showing the structure of the organic electroluminescence devices used with the 1st operation gestalt of the display of this invention.

[Drawing 4] The sectional view showing the main optical system in the 2nd operation gestalt of the display of this invention.

[Drawing 5] The reflection factor spectrum of the die clo IKKU filter layer which constitutes the die clo IKKU screen used with the 2nd operation gestalt of the display of this invention.

[Description of Notations]

100,400 Projection optical system

101 401 Die clo IKKU screen

102 Observer

103 Liquid Crystal Display Component

104 Organic Electroluminescence Devices

105 406 Projection lens

106 407 Case

107 409 Transparence substrate

108 Die Clo IKKU Filter Layer

109 410 Background

300 Glass Substrate

301 Anode Plate

302 Electron Hole Transportation Layer

303 Luminous Layer

304 Cathode

403R, 403G, 403B Liquid crystal display component

404R, 404G, 404B Organic electroluminescence devices

405 Dichroic Prism

408 Die Clo IKKU Filter

408R, 408G, and 408B Die clo IKKU filter layer